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Sir John Kingman
210 Clarkson Road
Cambridge CB# 0EH
United Kingdom

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14. ABSTRACT

The Final Proceedings for Mathematical Theory of Hyperbolic Systems of Conservation Laws, 24 March 2002 - 4 April 2003

The first week will focus on recent
developments on the theory of one-dimensional, nonlinear hyperbolic systems of conservation laws
including: entropy conditions, L1 well-posedness, singular limits, diffusive approximations, relaxation models, kinetic relations, shock wave structure,
links with thermodynamics, and compressible fluid dynamics.

The second week will focus on multidimensional aspects of hyperbolic conservation laws and on computational methods with applications to
multiphase flows. A partial list of topics includes: existence theory for multidimensional hyperbolic equations, transonic flow models, mathematical modeling of liquid-vapor flows, numerical schemes for
multiphase flows, nonconservative hyperbolic systems, real fluids, and material solid or fluid interfaces.

15. SUBJECT TERMS
EOARD, Thermodynamics, Shock Waves, Numerical Simulation

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a. REPORT	b. ABSTRACT	c. THIS PAGE			JAMES GREENBERG
UNCLAS	UNCLAS	UNCLAS	UL	3	19b. TELEPHONE NUMBER *(Include area code)* +44 (0)20 7514 4922

UNIVERSITY OF CAMBRIDGE
ISAAC NEWTON INSTITUTE
FOR MATHEMATICAL SCIENCES

Director: Sir John Kingman, FRS

20 Clarkson Road, Cambridge, CB3 0EH, U.K.
Tel: +44 (0)1223 335999 Fax: +44 (0)1223 330508
email: info@newton.cam.ac.uk
http://www.newton.cam.ac.uk/

From the Director *email: director@newton.cam.ac.uk, direct line: 335980*

Dr N Glassman
EOARD/AFOSR
223/231 Old Marylebone Road
London
NW15TH

23 April 2003

Dear Dr Glassman

Grant Number: FA8655-03-1-5030

In accordance with the grant approval document, I have pleasure in enclosing a report on the event that took place at the Institute in March and April supported by this grant and details of how the grant was used.

I confirm that the support of EOARD was recognised on the publicity material and enclose a copy of the poster confirming this. A full list of participants and the final timetables for the event are enclosed which are also available on our website at http://www.newton.cam.ac.uk/programs/NPA/npaw01p.html for week 1 and http://www.newton.cam.ac.uk/programs/NPA/npaw02p.html for week 2. Posters were displayed by various participants and these details are available at http://www.newton.cam.ac.uk/programs/NPA/posters.html.

The Institute is very grateful for this support and the interest shown in the work of the programme. If you require any further information please do not hesitate to contact me.

Yours Sincerely

Programme: Nonlinear Hyperbolic Waves in Phase Dynamics and Astrophysics (27 January to 11 July 2003)

Workshop: Mathematical Theory of Hyperbolic Systems of Conservation Laws

Dates: 24 March to 4 April 2003
Venue: Isaac Newton Institute for Mathematical Sciences, Cambridge, UK

The workshop was very successful and attracted a large enthusiastic participation and many of the worldwide experts in the field. Details of the scientific results of each week of the workshop are listed below.

Mathematical Theory of Hyperbolic Systems of Conservation Laws
Monday 24 March to Friday 28 March 2003.
Conference organized by C.M. Dafermos (Providence) and P.G. LeFloch (Palaiseau)

General Aims:
Nonlinear hyperbolic systems of conservation laws govern a broad spectrum of physical phenomena, in compressible fluid dynamics, nonlinear material science, etc. Such equations admit solutions that may exhibit shock waves and other nonlinear waves (propagating phase boundaries, fluid interfaces, etc) which play a dominant role in multiple areas of physics. Recent developments on the theory of one-dimensional systems were covered, including: entropy conditions, L1 well-posedness, singular limits, diffusive approximations, relaxation models, kinetic relations, shock wave structure, links with thermodynamics, etc.

Main themes covered:
a. general properties of hyperbolic systems arising in continuum physics, especially equations of nonlinear elastodynamics (S.K. Godunov, Novosibirsk), the Born-Infeld equations (Y. Brenier, Nice), and the projective theory of congruences (E.V. Ferapontov, Loughborough);

b. kinetic models, especially the transport equations from mathematical biology arising in chemotaxis and angiogenesis (B. Perthame, Paris) and the stability for discrete velocity Boltmann equations (A. Tzavaras, Heraklion);

c. well-posedness theory of systems of conservation laws, especially the existence theory for general flux-functions (T. Iguchi, Tokyo), the classical and nonclassical entropy solutions (P.G. LeFloch, Palaiseau), the qualitative behaviour of solutions (K. Trivisa, College Park), and the admissibility of solutions (T.-P. Liu, Stanford);

d. models of relaxation and diffusion, especially the vanishing viscosity approximations (A. Bressan, Trieste) and the stability of steady states (D. Serre, Lyon);

e. Euler and Navier-Stokes equations, especially the critical threshold in Eulerian dynamics (E. Tadmor, College Park), the diffusive relaxation approximations (P. Marcati, L'Aquila), and the asymptotic behavior of solutions (S. Nishibata, Tokyo).

Multiphase Fluid Flows and Multi-Dimensional Hyperbolic Problems
Monday 31 March to Friday 4 April 2003.
Conference organized by J. Ballmann (Aachen), P.G. LeFloch (Palaiseau), R. LeVeque (Seattle), and E.F. Toro (Trento)

General Aims:
This second week focused on multi-dimensional aspects of hyperbolic conservation laws and on computational methods with applications to multiphase flows. A partial list of topics included: existence theory for multi-dimensional hyperbolic equations, transonic flow models, mathematical modelling of liquid-vapour flows, numerical schemes for multiphase flows, nonconservative hyperbolic systems, real fluids, material interfaces, etc.

Main themes covered:
a. multi-dimensional hyperbolic problems, especially the mixed models for transonic flows (C.S. Morawetz, New York, and G.-Q. Chen, Evanston), the self-similar solutions to the Riemann problem in two space dimension (B. Keyfitz, Houston, and S.X. Chen, Shanghai), and the asymptotic stability of nonplanar Riemann solutions (H. Frid, Rio de Janeiro);

b. numerical methods, especially the kinetic decompositions, the evolution Galerkin Schemes (S. Noelle, Aachen), the simulation of cavitation processes (J. Ballmann, Aachen), the positive schemes (P.D. Lax, New York), the conservative methods for multi-dimensional multiphase problems (E.F. Toro, Trento);

c. propagation of interfaces (N. Nikiforakis, Cambridge, J. Greenberg, London), especially the computation of strong shocks hitting gas-gas interfaces (A. Marquina, Burjassot), the wave structure for elastic-plastic flow (R. Menikoff, Los Alamos);

d. various applications to turbulence theory (D. Drikakis, London), multi-fluid magnetohydrodynamics (S.A.E.G. Falle, Leeds), and the shallow water models (H. Peregrine, Bristol).

P LeFloch
April 2003